(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 179 869 A3

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
10.08.2005 Bulletin 2005/32

(43) Date of publication A2:
13.02.2002 Bulletin 2002/07

(21) Application number: **01119035.2**

(22) Date of filing: **07.08.2001**

(51) Int Cl.⁷: **H01M 6/10**, H01M 4/62,
H01M 4/48, H01M 4/02

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **08.08.2000 JP 2000239351**
11.10.2000 JP 2000310765

(71) Applicant: **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
Kadoma-shi, Osaka 571-8501 (JP)

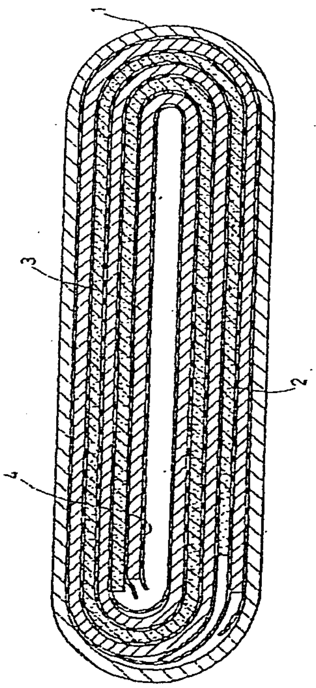
(72) Inventors:
- **Suzuki, Kohei**
  Yao-shi, Osaka 581-0024 (JP)
- **Kubota, Kazunori**
  Moriguchi-shi, Osaka 570-0014 (JP)
- **Kuroda, Akira**
  Hirakata-shi, Osaka 573-1146 (JP)
- **Kawamura, Motoi**
  Kadoma-shi, Osaka 571-0074 (JP)
- **Fukunaga, Masao**
  Minamikawachi-gun, Osaka 587-0062 (JP)
- **Ohata, Tsumoru**
  Kyoto-shi, Kyoto 612-8016 (JP)

(74) Representative: **Pellmann, Hans-Bernd, Dipl.-Ing.**
Tiedtke-Bühling-Kinne & Partner GbR,
TBK-Patent,
Bavariaring 4
80336 München (DE)

(54) Non-aqueous electrolyte secondary battery and positive electrode for the same

(57) A non-aqueous electrolyte secondary battery comprises: a positive electrode sheet comprising a positive electrode mixture containing a lithium-containing transition metal oxide as an active material and a particulate binder; a negative electrode sheet comprising a negative electrode mixture containing a carbon material; a separator interposed between the positive electrode sheet and the negative electrode sheet; and a non-aqueous electrolyte containing a lithium salt, wherein the positive electrode sheet and the negative electrode sheet are wound with the separator interposed therebetween to form an electrode assembly, and the positive electrode mixture has an active material density of 3.0 to 4.0 g/ml. The battery has a long life, high energy density and high output.

F I G. 1



Printed by Jouve, 75001 PARIS (FR)

European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 9035

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	EP 0 973 211 A (SONY CORPORATION) 19 January 2000 (2000-01-19)	1-3	H01M6/10 H01M4/62 H01M4/48 H01M4/02
Y	* paragraph ‘0008! * * paragraph ‘0027! - paragraph ‘0028! * * example 1 * -----	6,7,9	
X	EP 0 918 361 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD) 26 May 1999 (1999-05-26)	1	
Y	* paragraph ‘0008! - paragraph ‘0016! * * paragraph ‘0027! * * examples 1-3 * -----	6,7,9	
X	EP 0 814 525 A (TOSHIBA BATTERY CO., LTD) 29 December 1997 (1997-12-29)	1	
Y	* example 44; table 4 * -----	6,9	
Y	EP 0 789 412 A (FUJI PHOTO FILM CO., LTD) 13 August 1997 (1997-08-13) * page 10, line 45 - line 53 * * examples 1,2; table 4 * -----	6,7,9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01M

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	15 June 2005	Fernandez Morales, N

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

4

EPO FORM 1503 03.82 (P04C01)

European Patent
Office

Application Number
EP 01 11 9035

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☒ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

1,2,3,6,7,9

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

European Patent
Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 01 11 9035

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3

A non-aqueous electrolyte secondary battery comprising a positive electrode sheet comprising a positive electrode mixture containing lithium-containing transition metal oxide as an active material and a particulate binder, the positive electrode mixture having an active material density of 3.0 to 4.0 g/ml and the electrode assembly having an elliptic transverse section.

---

2. claims: 1, 4, 5

A non-aqueous electrolyte secondary battery comprising a positive electrode sheet comprising a positive electrode mixture containing lithium-containing transition metal oxide as an active material and a particulate binder, the positive electrode mixture having an active material density of 3.0 to 4.0 g/ml and containing a particulate binder which is an elastic copolymer comprising 2-ethylhexylacrylate unit, an acrylic acid unit and an acrylonitrile unit.

---

3. claims: 1, 6, 7, 9

A non-aqueous electrolyte secondary battery comprising a positive electrode sheet comprising a positive electrode mixture containing lithium-containing transition metal oxide as an active material and a particulate binder, the positive electrode mixture having an active material density of 3.0 to 4.0 g/ml, containing 0.4 to 2 parts by weight of a particulate binder per 100 parts by weight of active material, containing not less than 2 and less than 4 parts by weight of a conductive agent per 100 parts by weight of active material, said conductive agent comprising graphite (A) and carbon black (B) and a weight ratio of (A)/(B) being 20/80 to 80/20.

---

4. claims: 1, 8

A non-aqueous electrolyte secondary battery comprising a positive electrode sheet comprising a positive electrode mixture containing lithium-containing transition metal oxide as an active material and a particulate binder, the positive electrode mixture having an active material density of 3.0 to 4.0 g/ml and containing a thickening agent having a polyethylene structure.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 01 11 9035

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-06-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0973211 A	19-01-2000	EP 0973211 A1	19-01-2000
		US 6746798 B1	08-06-2004
		WO 9925036 A1	20-05-1999
EP 0918361 A	26-05-1999	EP 0918361 A1	26-05-1999
		US 6114065 A	05-09-2000
		CN 1495946 A	12-05-2004
		CN 1516306 A	28-07-2004
		CN 1219287 A ,C	09-06-1999
		ID 21195 A	06-05-1999
		JP 10312811 A	24-11-1998
		WO 9840919 A1	17-09-1998
		KR 2000010932 A	25-02-2000
EP 0814525 A	29-12-1997	JP 3614984 B2	26-01-2005
		JP 10012220 A	16-01-1998
		JP 3614990 B2	26-01-2005
		JP 10055799 A	24-02-1998
		JP 3643447 B2	27-04-2005
		JP 10064521 A	06-03-1998
		JP 10064522 A	06-03-1998
		CA 2207801 A1	19-12-1997
		EP 0814525 A2	29-12-1997
		KR 269819 B1	16-10-2000
		US 6314638 B1	13-11-2001
		US 2001012588 A1	09-08-2001
EP 0789412 A	13-08-1997	AU 3754195 A	23-05-1996
		CA 2203802 A1	09-05-1996
		DE 69514678 D1	24-02-2000
		DE 69514678 T2	15-06-2000
		EP 0789412 A1	13-08-1997
		US 6019802 A	01-02-2000
		CN 1168742 A ,C	24-12-1997
		WO 9613873 A1	09-05-1996

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

THIS PAGE BLANK (USPTO)